

Interim Planning Report



Summary

US Highway 101 Interchange with Sir Francis Drake Boulevard in Marin County



prepared for

Marin County Congestion Management Agency



May 2002



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This planning report summarizes preliminary planning and engineering studies which examined possible alternatives to address transportation problems for the U.S. Highway 101 (US 101) Sir Francis Drake Boulevard interchange in central Marin County. Seven potential choices have been delineated, but a consensus has not been reached as to

which improvements should be further developed. This report is intended as a resource to help the County and local communities reach decisions that will guide the next stages of Project development.

Site Description and Existing Conditions

US 101 is an important link in the Bay Area's regional transportation system and the primary north-south, multimodal transportation corridor for Marin County and the North Bay. This freeway is the only continuous, high-capacity, north-south highway serving Marin and Sonoma counties north of the Golden Gate Bridge. The Sir Francis

Drake Boulevard interchange on US 101 (also known as the "Greenbrae" interchange) is located in central Marin County, approximately 10 miles north of the Golden Gate Bridge. The interchange is a relatively complex three-level facility built over Corte Madera Creek and surrounding wetlands. The basic physical design is a diamond

Call for Action -- Service Improvements Clearly Needed

Improvements to the Sir Francis Drake Boulevard and other nearby US 101 interchanges are clearly needed. The existing roadway geometry and interchange spacing does not meet current California Department of Transportation (Caltrans) freeway design standards. The result is daily recurring traffic congestion in the corridor and an accident history much higher than average. Future traffic growth will further exacerbate current deficiencies.

interchange, but the configuration is supplemented with a direct two-lane ramp connection from US 101 northbound to Sir Francis Drake Boulevard westbound as well as a ramp structure from westbound Sir Francis Drake Boulevard to southbound US 101. Over 87,000 vehicles

per day entered and exited US 101 via this interchange in 1998, the highest volume of interchange traffic in Marin County.

South of the Greenbrae interchange, there are nearby US 101 interchanges at Fifer Avenue/ Industrial Way and Madera Boulevard. These interchanges are too close together. On southbound US 101, there are four interchanges within 1.4 miles between the Greenbrae interchange and the Tamalpais Drive interchange in Corte Madera.

Northbound US 101 has three interchanges in that same distance. The spacing is substantially below Caltrans' recommended freeway standard of 1 mile or more between interchanges. North of Sir Francis Drake Boulevard, the next US 101 interchange is the US 101/1-580 system junction, 1.3 miles away.

Sir Francis Drake Boulevard

Sir Francis Drake Boulevard is the busiest arterial roadway in Marin County. It is a four-lane road through the Greenbrae interchange area. However, turning lanes at the freeway ramp junctions reduce the roadway to only one continuous through lane eastbound and westbound. Signalized freeway ramp intersections are spaced at approximately 300 feet, again below design standards of 400 feet (minimum) to 600 feet (preferable).

Quality of Traffic Operations

The US 101 corridor through Central and Northern Marin County is among the ten worst congested corridors in the nine-county San Francisco Bay Area. US 101 carries average traffic volumes approaching 190,000 vehicles per day in the segment between Corte Madera and the Marin Civic Center to the north. Traffic flow on much of the US 101 corridor is at saturation levels during peak hours. Stop and go conditions prevail regularly for northbound PM peak hour traffic from the Richardson Bay Bridge through central San Rafael. Morning peak hour traffic through the Greenbrae interchange area is predominantly southbound. Evening

peak hour northbound traffic volume is higher than morning peak volume.

The short distance separation and heavy traffic friction between the Greenbrae interchange and nearby Fifer Avenue and Industrial Way ramps immediately south contributes to significant traffic turbulence. Peak period queues are a daily occurrence on interchange ramps and often onto US 101. Peak period traffic on US 101 through Corte Madera and Larkspur is regularly reduced to stop and go conditions and long queues.

Safety Performance

Traffic conditions and design issues in the Greenbrae interchange vicinity yield a poor safety history; crash rates for US 101 are two to three times higher than average. Crash rates also are higher than average on most of the Sir Francis Drake Boulevard interchange ramps.

Short-Trip Travel Patterns

Over 60 percent of the Industrial Way northbound on-ramp traffic is destined to Sir Francis Drake Boulevard (not the US 101 freeway). The reverse is true for southbound traffic exiting US 101 at the Fifer Avenue off-ramp. Many drivers are using the freeway and ramps only for short local trips to cross Corte Madera Creek because there is no alternate route. These short-trip movements create safety issues and cause significant freeway congestion.

Future Traffic Projections

Future traffic projections by the Marin County Congestion Management Agency and the Metropolitan Transportation Commission indicate higher traffic demand. Critical ramp volumes for the southbound and the northbound off

The LIS 101 corridor is among the ten worst congested corridors in the Bay Area, with average traffic volumes approaching 190,000 vehicles per day between Corte Madera and the Marin Civic Center

ramps at Sir Francis Drake Boulevard are projected to increase up to 30 percent.

Planned HOV Gap Closure Project

A US 101 "High-Occupancy Vehicle Gap Closure Project" is underway to complete a continuous HOV lane in the southbound roadway between North San Pedro Road and the existing HOV lanes south of Lucky Drive. This HOV segment may be a reversible lane for southbound and northbound traffic with a movable barrier to delineate the direction of reversible operation.

Alternative Improvement Concepts

Seven different alternatives were developed to address design deficiencies, traffic congestion, and safety issues in the vicinity of the Sir Francis Drake Boulevard interchange on US 101. Each alternative is briefly described below and is detailed in Figures ES-1 and ES-2 following this summary.

Alternative 1: Rebuild the Sir Francis Drake Boulevard Interchange. Update and improve the Sir Francis Drake Boulevard interchange to Caltrans design and traffic operations standards for accommodating current and future traffic. This alternative includes advanced traffic management features - HOV priority lane access, ramp metering and vehicle storage. Because the interchange is over water and meeting the above standards requires significant structural widening and changes, these improvements would be very difficult and costly. Moreover, rebuilding or improving the Greenbrae interchange will not address the primary issue of inadequate spacing between successive interchanges on US 101. The nearby ramps create severe traffic

turbulence which substantially degrades safety and traffic operation. Thus, desired traffic operation cannot be realized without significantly altering nearby interchanges.

√ *Rebuilding the Greenbrae interchange will improve operations and safety locally at a high cost.*

Alternative 2: Limited Improvements to Existing Interchanges.

This limited expenditure alternative retains most existing access, but widens interchange ramps, adds auxiliary lanes, and reconfigures access and egress to improve safety and operations. It restripes the southbound Greenbrae on ramp to two lanes and adds an auxiliary lane to Fifer Avenue; it also widens the northbound off-ramp to Sir Francis Drake Boulevard to enable two lanes westbound and two lanes eastbound. The Fifer Avenue off-ramp is converted to two lanes and Nellen Avenue

reconfigured to a cul-de-sac north of Fifer Avenue. Sir Francis Drake Boulevard is re-aligned and signal intersections updated.

√ *Limited improvements around the Greenbrae interchange will improve freeway operations somewhat as a stop gap measure.*

Alternative 3: Restructure US 101 Interchange Access.

Remove US 101 ramps and interchanges at Fifer Avenue/ Lucky Drive, Industrial Way, and Madera Boulevard. Update the Greenbrae and Tamalpais Drive interchanges as the only access points in the corridor. Improve connecting roadways and intersections near these interchanges as well as local traffic circulation on Madera, Tamal Vista

Boulevard, Wornum Drive, Redwood Highway and Lucky Drive.

√ Removing the Fifer, Madera, and Lucky/Industrial interchanges will greatly improve freeway operations but degrade local circulation

Alternative 4: Construct Wornum Drive Full-Service Interchange.

Build a new full-service interchange at Wornum Drive and eliminate the Lucky Drive/Industrial Way, Fifer Avenue and Madera Boulevard interchanges. Realign the Redwood Highway/Wornum Drive intersection to make room for the Wornum Drive interchange, close Redwood Highway north of Wornum Drive and provide commercial property access north of Wornum Drive with an eastward extension of Wornum Drive and Industrial Way. Restripe the Sir Francis Drake Boulevard southbound on-ramp to two lanes, widen the northbound off-ramp to two lanes east and west, plus lengthen with auxiliary lanes as in Alternative 2. Re-align Sir Francis Drake Boulevard ramp intersections and improve alignment and traffic signal control through the interchange area

√ Creating a new interchange at Wornum to replace Fifer, Madera, and Lucky l Industrial will improve operations and safety while preserving transit and local access.

Alternative 5: Construct Wornum Drive Half-Diamond Interchange.

Construct a new half-diamond interchange at Wornum Drive and eliminate the Fifer Avenue/Lucky Drive/ Industrial Way interchanges. The Wornum Drive half-diamond interchange would consist of a southbound off-ramp and a northbound

on-ramp; the existing Madera Boulevard southbound on-ramp would be retained. Otherwise similar to Alternative 4.

√ Creating a partial new interchange at Wornum to replace Fifer and Lucky l Industrial will improve operations and safety but reduce local access and transit accessibility.

Alternative 6: Construct Wornum Drive Extension Across Corte Madera Creek.

Extend Wornum Drive roadway east from US 101 along the railroad right-of way and construct a new bridge structure over the Corte Madera Creek channel to Sir Francis Drake Boulevard. Eliminate the Lucky Drive/ Industrial Way and Fifer Avenue ramps. This alternative removes local trips from the freeway while retaining local circulation within and between the Corte Madera and Larkspur communities. Includes Greenbrae interchange and Sir Francis Drake Boulevard improvements as in other alternatives.

√ Building a Wornum Drive extension across Corte Madera Creek will improve local circulation and freeway operations but will have environmental impacts.

Alternative 7: Add New Ramp (West I-580 bound 580 to Southbound US 101) Plus Wornum Drive Extension and Creek Crossing.

Construct a new ramp from westbound I-580 to southbound US 101 in San Rafael. This will redirect some traffic from Sir Francis Drake Boulevard and connect US 101 ramps. It will enable Richmond-San Rafael Bridge traffic to use US 101 in lieu of Sir Francis Drake Boulevard and thus relieve overtaxed Greenbrae interchange ramps, as well as improve local circulation in San Rafael to and from employment sites on the Bayside of I-580. Also remove Fifer

Avenue/Lucky Drive and Industrial Way ramps and extend Wornum Drive east with a bridge crossing of Corte Madera Creek as in Alternative 6 to reroute local traffic from the interchange. Include Greenbrae interchange and Sir Francis Drake Boulevard improvements as in other alternatives.

√ Building the Wornum extension and adding to the I-580/US 101 interchange will improve freeway operations and local circulation, but costs will be high.

Pedestrian and Bicycle Circulation

Bicycle and pedestrian circulation in the vicinity of the Greenbrae interchange, and particularly across Corte Madera Creek, is an important component of County transportation plans. All seven of the alternatives will provide improved non-motorized access across the Creek and connections to other bike and pedestrian trails or paths.

A viable planning solution will require the support of affected stakeholders and political jurisdictions. An open and inclusive process must consider all realistic options.

Transit Service and Accessibility

US 101 traffic congestion is a serious issue throughout Marin and Sonoma Counties. Improved transit service options are needed to address travel needs and to counter adverse traffic congestion impacts on travelers and communities. Golden Gate Transit runs freeway express bus services along US 101 with passenger access/egress at bus pads near ramps. The Metropolitan Transportation Commission's *Bay Area Transportation Blueprint* also emphasizes bus rapid transit service on freeway HOV lanes. Bus service access along US 101 and Larkspur ferry connections are important elements to

encourage a shift from autos to transit. Alternatives 3 and 5 do not accommodate transit well; Alternatives 6 and 7 enable better connections to the Larkspur Ferry Terminal, but poorer freeway express bus access.

Conclusions

This project was originally defined and scoped as a typical engineering project study report to define engineering improvements focused on US 101 and the Sir Francis Drake Boulevard interchange. It is clear that the issues extend beyond the interchange area; a broader framework and perspective is needed Achieving congestion relief for

US 101 and the Greenbrae interchange will entail removal or modification of other US 101 on- and off ramps, possibly replacing them with a new interchange at Wornum Drive midway between the Sir Francis Drake Boulevard and Tamalpais

Drive interchanges. These actions would affect local street circulation, traffic volumes, and property access provisions. Thus, concurrence and consensus of affected jurisdictions is important before further effort in engineering studies and development of an improvement plan.

No clear consensus for a preferred solution has yet emerged. Traffic congestion and safety problems on the US 101 corridor are issues that affect each of the political jurisdictions and their resident and business communities. An evaluation of the alternatives, illustrated in Figure ES-2, was developed by a group of technical staff working from these jurisdictions. The evaluation results suggested that Alternatives 4, 6, and 7 can best meet the transportation needs.

However, development of a viable planning solution will require the support of the affected stakeholders and political jurisdictions. This document is intended to inform the project stakeholders and to prompt development of an open and inclusive process to systematically consider all realistic options and to forge a consensus for an improvement scheme that can be successfully implemented.

Next Steps

No simple or single improvement at the Sir Francis Drake Boulevard interchange is likely to significantly relieve traffic congestion or improve safety performance. The traffic and safety problems are complex. Achieving desired transportation and community objectives will require a family of improvements along the

US 101 corridor through Corte Madera and Larkspur. The spectrum of alternatives presented in this interim report would affect the adjoining

Planning Goals

- *Educate and inform key stakeholders regarding traffic congestion, safety, access and circulation, and community planning issues facing the communities of Corte Madera, Larkspur, and Marin County*
- *Define and present candidate solutions to these issues, describing merits, impacts, and long-term effectiveness of each potential alternative solution*
- *Obtain Input from stakeholders regarding potential solutions.*
- *Work to Address critical issues, build a shared understanding, and create a consensus among the key stakeholders on a preferred solution*

communities, thousands of corridor travelers, individuals, property owners, and business interests.

A collaborative planning effort is recommended to forge a preferred solution, spearheaded by the Marin County Congestion Management Agency and undertaken jointly with Larkspur, Corte Madera and County representation. The planning initiative should address integration of

transportation alternatives and community planning, facilitate a decision-making process, provide an open forum to engage public involvement and participation, and build a consensus around a preferred, implementable solution.

Alternative 1 Rebuild Sir Francis Drake Interchange

Purpose:

- Update Sir Francis Drake Interchange to meet current design standards, improve level of service, and include traffic management system elements

Description:

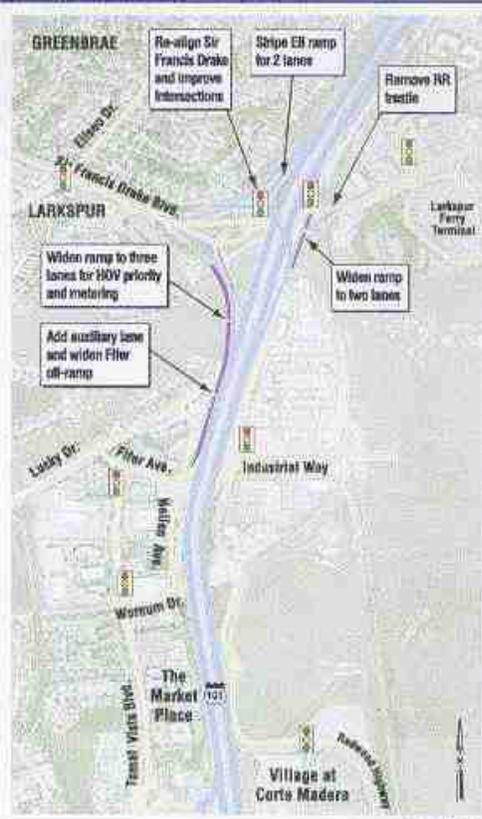
- Improve interchange to Caltrans design standards
- Widen SB on-ramp to three lanes and NB off-ramp to two lanes eastbound
- Incorporate HOV priority access, ramp metering and vehicle storage space
- Re-align Sir Francis Drake and improve intersections and signal control
- Address sensitive environmental setting and required bridge structure changes

Benefits:

- Improved traffic operations and safety at the Sir Francis Drake interchange

Constraints:

- Existing interchange is on structure and over water – improvements will be very costly and environmentally sensitive
- Improvements at Sir Francis Drake will not address freeway traffic problems due to interference of nearby interchanges
- Traffic safety risk remains with mix of low-speed traffic entry from nearby interchanges and high-speed freeway traffic



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Alternative 3 Restructure US 101 Interchange Access

Purpose:

- Upgrade route to Caltrans interchange spacing and design criteria to improve freeway operations and safety

Description:

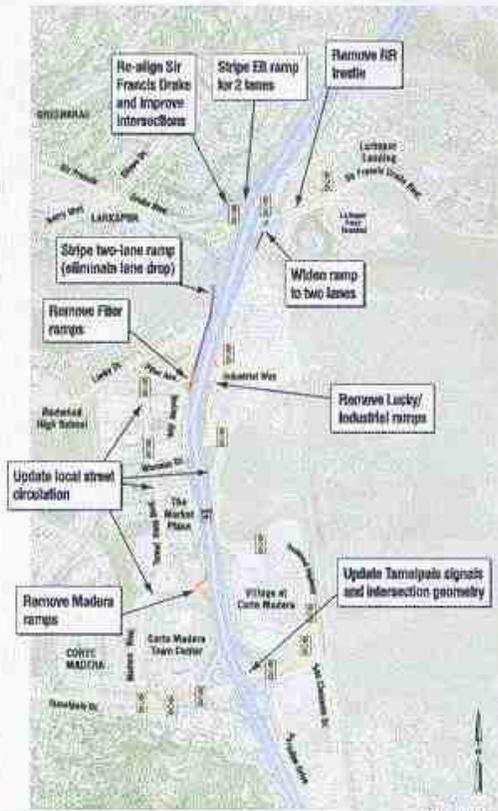
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Remove ramps at Lucky/Industrial, Fifer, and Madera
- Extend auxiliary lane southbound from Sir Francis Drake through Fifer
- Re-align Sir Francis Drake and improve intersections and signal control
- Upgrade Tamalpais interchange, ramp and nearby signal intersections to accommodate shifted traffic demand
- Improve local traffic circulation on Madera, Tamal Vista, Wornum, Redwood Highway and Lucky Drive

Benefits:

- Improved interchange spacing and geometry will greatly improve traffic operations and safety
- Low cost to close interchanges

Constraints:

- Closed ramps will increase traffic on local streets
- Access to areas around Fifer/Lucky and Industrial Road will be degraded
- Some local trips across Corte Madera Creek will shift to Bon Air Road



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Alternative 2 Limited Improvements to Existing Interchanges

Purpose:

- Implement limited physical and operational improvements on US 101 and Sir Francis Drake to enhance traffic operations and safety while retaining most existing access

Description:

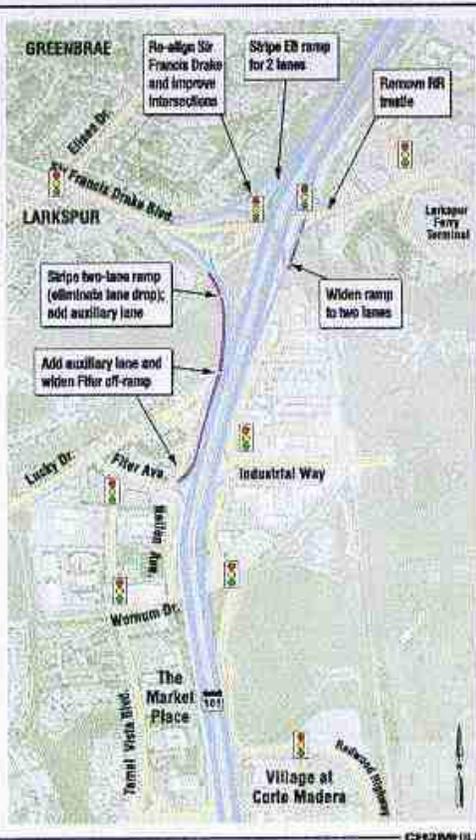
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Add auxiliary lane southbound between Sir Francis Drake (two lane on-ramp) and Fifer
- Widen Fifer southbound off-ramp and cul-de-sac Nellen
- Add auxiliary lane northbound between Lucky and Sir Francis Drake
- Re-align Sir Francis Drake and improve intersections and signal control

Benefits:

- Somewhat improved safety and freeway operations south of the Sir Francis Drake Interchange
- Retains most access while addressing the most critical issues
- Relatively high traffic operations and safety payoff for limited capital investment

Constraints:

- Improvements are a "stopgap" measure – not long-term solutions
- Traffic safety risk remains with mix of low-speed traffic entry from nearby interchanges and high-speed freeway traffic
- Widening Sir Francis Drake NB off-ramp involves wetlands and sensitive water environment
- Does not resolve critical interchange spacing deficiency – too many access points between Tamalpais and Sir Francis Drake



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Alternative 4 Construct Wornum Drive Full Service Interchange

Purpose:

- Improve freeway operations and community access with new interchange

Description:

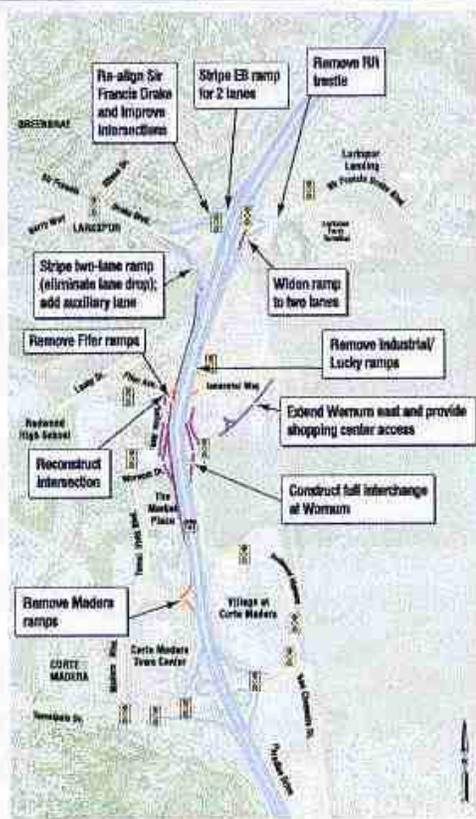
- Construct new full-service diamond interchange at Wornum Drive
- Remove ramps at Lucky Drive (northbound) and Fifer/Madera (southbound)
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Extend auxiliary lane southbound from Sir Francis Drake through Fifer
- Re-align Sir Francis Drake and improve intersections and signal control
- Extend Wornum east along railroad alignment to Industrial Rd and create commercial property access east of Redwood
- Cul-de-sac Nellen and Redwood north of Wornum. Shift Redwood east at Wornum

Benefits:

- Improve freeway operations with better interchange spacing and improved design
- Safety is enhanced with interchange spacing and design standards upgrade
- Sir Francis Drake interchange improvement and auxiliary lanes improve traffic capacity and performance
- Better traffic operations on Sir Francis Drake because Lucky traffic does not have to pass through Sir Francis Drake ramp signal

Constraints:

- Very minor shift in local street traffic patterns through Wornum
- Cul-de-sacs would alter some traffic to accommodate new interchange
- Local traffic would still use the freeway for short trips across Corte Madera Creek



RR = Railroad
EB = Eastbound
NB = Northbound
SB = Southbound
WB = Westbound
HOV = High Occupancy Vehicle

Note: These drawings are a preliminary concept diagram for discussion purposes only. They are not drawn to an exact scale and the alignments shown are approximate.

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Figure ES-
Summary of Alternative:

Alternative 5

Construct Wornum Drive Half Diamond Interchange

Purpose:

- Construct a partial new interchange at Wornum to improve interchange spacing, traffic operations, and safety

Description:

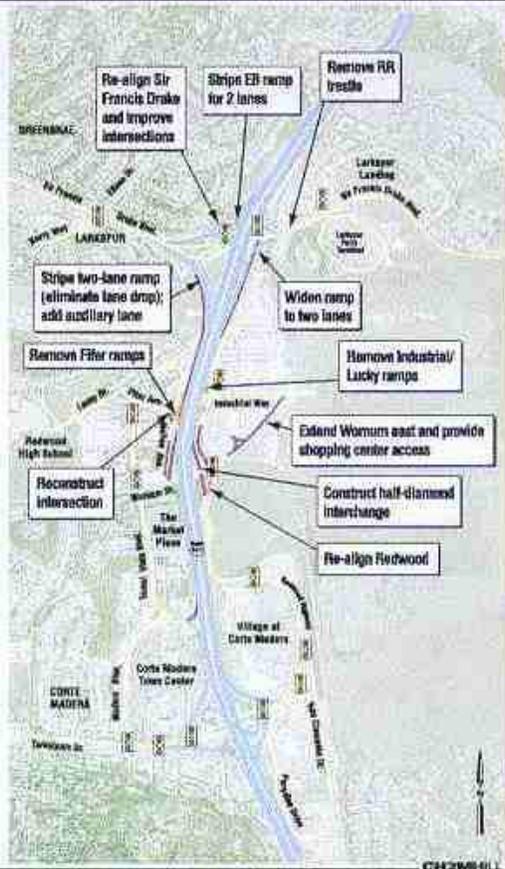
- Construct a new half-diamond interchange at Wornum with on and off ramps to and from the north only
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Remove ramps at Lucky (northbound) and Fifer/Madera (southbound)
- Add auxiliary lane southbound from Greenbrae southbound on-ramp to Wornum
- Extend Wornum east along railroad alignment to industrial and create commercial property access east of Redwood
- Cul-de-sac Neilen and Redwood north of Wornum. Shift Redwood east at Wornum
- Re-align Sir Francis Drake and improve intersections and signal control

Benefits:

- Freeway operations improve with better interchange spacing and updated design
- Safety is enhanced with interchange spacing and design standards upgrade
- Sir Francis Drake interchange improvement and auxiliary lanes improve traffic capacity and performance
- Better traffic operations on Sir Francis Drake because Lucky traffic does not have to pass through Sir Francis Drake ramp signal
- Madera ramps retain access to Corte Madera Town Center and adjoining commercial development

Constraints:

- High cost for major improvements
- Construction of Wornum extension and Creek bridging involves highly sensitive water, wetlands, and environmental areas; will require mitigation
- New intersection on Sir Francis Drake requires signal control integration
- Traffic may not shift to the I-580/US 101 route due to distance and freeway congestion
- Fewer access points on US 101 will increase traffic using the Tamalpais interchange



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Alternative 7

Add New Ramp (Westbound I- 580 to Southbound US 101) Plus Wornum Drive Extension and Creek Crossing

Purpose:

- Shift traffic away from Greenbrae interchange with US 101/I-580 system connection and Wornum Extension for local traffic

Description:

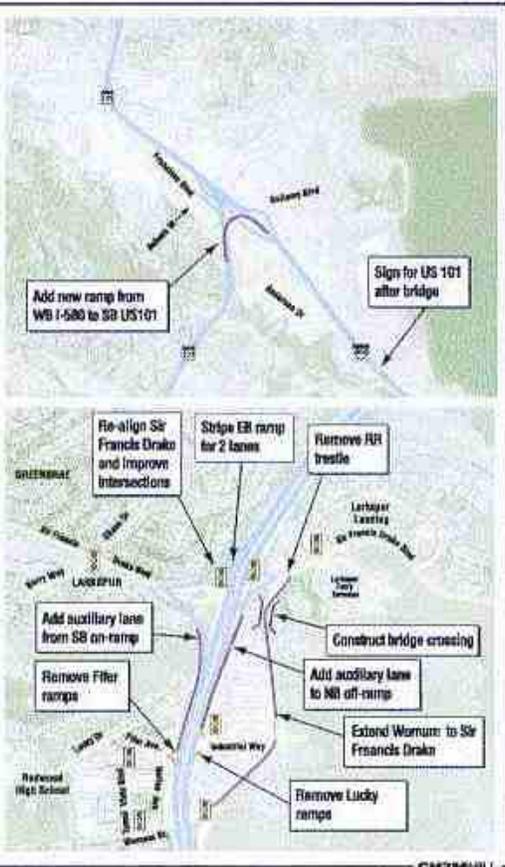
- Add direct freeway-to-freeway ramp from westbound I-580 to southbound US 101
- Extend Wornum east from US 101 and bridge Corte Madera Creek to Sir Francis Drake
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Remove ramps at Lucky (northbound) and Fifer (southbound)
- Add auxiliary lane from Greenbrae southbound on-ramp to Wornum
- Re-align Sir Francis Drake and improve intersections and signal control

Benefits:

- Reduced traffic on Sir Francis Drake by shifting traffic to I-580 and US 101
- Improved safety and local circulation by separating local, short trips from freeway higher-speed traffic
- Improved freeway operation and safety due to fewer access points
- Bicycle and pedestrian circulation enabled across Corte Madera Creek
- Residents and visitors gain alternative access across Corte Madera Creek

Constraints:

- High cost for major improvements
- Construction of Wornum extension and Creek bridging involves highly sensitive water, wetlands, and environmental areas; will require mitigation
- New intersection on Sir Francis Drake requires signal control integration
- Traffic may not shift to the I-580/US 101 route due to distance and freeway congestion
- Fewer access points on US 101 will increase traffic using the Tamalpais interchange



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Alternative 6

Construct Wornum Drive Across Corte Madera Creek

Purpose:

- Separate longer freeway trips and local trips to improve traffic operations, safety and local access

Description:

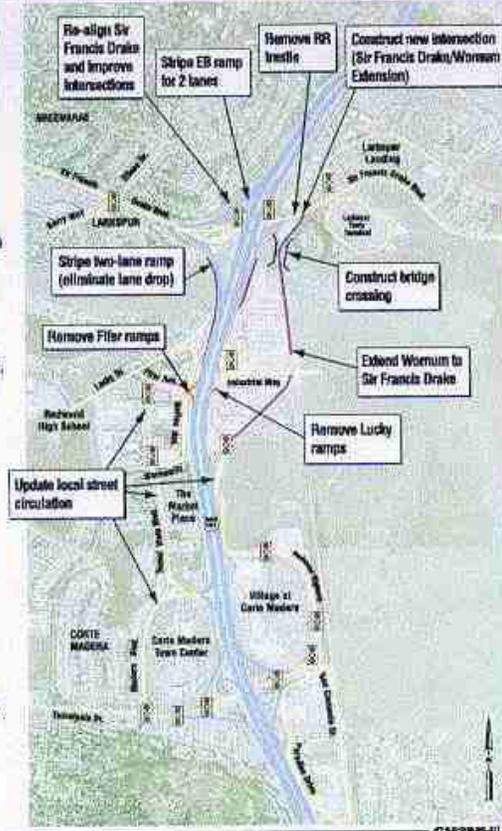
- Extend Wornum from US 101 east and bridge Corte Madera Creek to Sir Francis Drake
- Restripe Greenbrae interchange SB on-ramp to two lanes and widen NB off-ramp to two lanes eastbound
- Remove ramps at Lucky (northbound) and Fifer (southbound)
- Add auxiliary lane southbound from Greenbrae southbound on-ramp to Wornum
- Re-align Sir Francis Drake and improve intersections and signal control
- Create NW intersection (Wornum/Sir Francis Drake for access to Larkspur Landing, the Ferry Terminal, and the Richmond-San Rafael Bridge)
- Include bicycle and pedestrian circulation in Corte Madera Creek crossing

Benefits:

- Separation of local, short-trip traffic and freeway high speed, longer trip traffic enhances safety, improves freeway and ramp traffic operation and assists local circulation
- Sir Francis Drake interchange improvement and auxiliary lanes improve traffic capacity and performance
- Better traffic operations on Sir Francis Drake because traffic from Lucky is not routed through the Sir Francis Drake ramp signal
- Bicycle and pedestrian circulation enabled across Corte Madera Creek.
- Residents and visitors gain alternative access across Corte Madera Creek

Constraints:

- Wornum extension construction and Creek bridging involve highly sensitive water, wetlands, and environmental areas; will require mitigation
- New intersection on Sir Francis Drake requires signal control integration
- Fewer access points on US 101 will increase traffic using the Tamalpais interchange



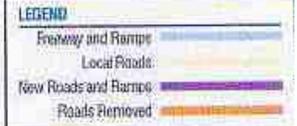
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Alternatives Evaluation Scorecard

Alternative	Benefits						Impacts	
	Traffic Operations (Freeway)	Traffic Operations (Intersections)	Design Standards	Safety	Transit Service	Local Circulation	Environmental	Cost
1	Minor	Major	Moderate	Minor	Moderate	Minor	Major	Major
2	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate
3	Major	Degradation	Moderate	Major	Degradation	Degradation	Moderate	Moderate
4	Major	Moderate	Major	Major	Moderate	Moderate	Major	Major
5	Moderate	Moderate	Moderate	Moderate	Degradation	Moderate	Moderate	Major
6	Major	Major	Moderate	Major	Minor	Moderate	Major	Major
7	Major	Major	Major	Major	Moderate	Major	Major	Major

Major Moderate Minor Degradation

Major Moderate Minor



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 WB = Westbound
 HOV = High Occupancy Vehicle

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Figure ES-2
 Summary of Alternatives

